Baldwin (A. S.) Compliments of the Author

AN ADDRESS

ON THE

CLIMATOLOGY OF FLORIDA,

DELIVERED BEFORE THE

MEDICAL ASSOCIATION

OF THE

STATE OF FLORIDA,

AT THEIR ANNUAL MEETING, HELD IN THE CITY OF JACKSONVILLE, ON THE 17TH AND 18TH FEBRUARY, 1875,

BY

A. S. BALDWIN, M.D., PRESIDENT.

presented by author

CHARLESTON, S. C.
WALKER, EVANS & COGSWELL, PRINTERS,
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Gentlemen of the
Medical Association of the State of Florida:

As many friends, for whom I entertain a high regard, have solicited it, and with whose wishes I am disposed to comply, I have chosen Climatology, or rather the Meteorology of Florida as the subject of an address which this Association requires annually from its President.

While sensibly conscious of my inability to do full justice to so important a subject, I am still willing to make any contribution in my power towards the elucidation of it, and the establishment of a better knowledge of our climate among the Profession and others interested abroad, and among whom, after so much has been written and disseminated, a great variety of opinions seems still to exist, even while our neighbours of the North and West, in considerable and constantly increasing numbers, are mak-

ing our State a winter resort, and, in many instances, a permanent abode. And why is there such a want of correct information, in regard to Florida, her topography and resources, her soil and productions, and of the true character of her climate, as it affects mankind, residing summer and winter, and year after year, within her borders? Hitherto scores of invalid visitors have kept partial meteorological records during their winter sojourn here, and have been sending them to their respective homes for publication, accompanied by such comments and impressions as their state of health and feelings might at the time dictate. Sometimes favorable impressions were conveyed, and sometimes the reverse, and these conflicting reports, seem to have produced upon the minds of medical men, as well as of others, an impression that our climate was fickle, and as variable as were the reports concerning it. Hence, it is important that whatever of reliable meteorological data we may possess, should be collected and subjected to an analysis, and put into a shape that shall impart the requisite information, and correct the false impressions which seem to have been made from unreliable reports based on very imperfect data. In an endeavour to accomplish this, I have been able to obtain numerous records of meteorological observations made at various stations in East and South Florida, but one from the Middle, and from but two in West Florida. These, added to my own observations for the past thirty-six years, comprise the material from which I propose to work out the problem imposed upon me as my task on this occasion.

We will first determine what is meant by the term climate?

According to Humboldt: "The term climate, taken in its more general sense, indicates all the changes in the atmosphere, which sensibly affect our organs as temperature, humidity, variations in barometrical pressure, the calm

state of the atmosphere, or the action of opposite winds, the amount of electrical tension, the purity of the atmosphere, and its admixture with more or less noxious gaseous exhalations, and, finally, the degree of ordinary transparency and clearness of the sky, which is not only important, with respect to the increased radiation from the earth, the organic development of plants, and the ripening of fruits, also, with reference to its influence on the feelings and mental condition of men."

"Reclus" gives the following as his definition: "All the facts of physical geography, the relief of continents and of islands, height and direction of the system of mountains, the extent of forests, savannas and cultivated lands, the width of valleys, the abundance of rivers, the outline of the coasts, the marine currents and winds, and all the meteoric phenomena of the atmosphere, vapours, fogs, clouds, rains, lightning, and thunders, magnetic currents, or as Hippocrates said, more briefly, "*The places, the waters, and the airs*," constitute in connection with latitude and longitude, what is called a climate." These definitions are sufficiently comprehensive to cover the entire subject, and they give a full enumeration of the different factors or elements of climate. The first, in Humboldt's enumeration is, "*Temperature.*" To elucidate this, we have ample materials, and to make it clear and easily understood, I have tabulated the abstracts of mean temperature taken at seventeen stations, besides my own. (See Appendix.) The names of the stations, their latitude and longitude is given, and the number of years and parts of years, during which these observations were made, are also given, and I have also added to the tables and enclosed in brackets the abstracts of other observations since the following deductions were made, and which do not enter into them. From this table we learn that the mean temperature of the spring for the entire State is 71° 62; for

the summer, 80° 51; for autumn, 71° 66; for winter, 60° 04; and for the year, 70° 95. And for the stations on latitude 82° N, and south of it, for the spring, we have 74° 94; for summer, 81° 93; for autumn, 76° 57; for winter, 63° 69; and for the year, 74° 87. For the stations north of latitude 28° N, we have for the spring, 70° 66; for summer, 80° 10; for autumn, 70° 23; for winter, 58° 29; and for the year, 69° 82. There is not exhibited any great difference between the northern and southern portions of the State, but enough to afford a choice of temperature during the different seasons, if the visitor desires change. During the spring, the temperature south of 28° latitude, is 4° 28 higher; and for summer, 1° 83; for autumn, 6° 34; and for winter, 5° 40 higher than it is north of lat. 28°.

It will be observed, that the temperature south of latitude 28° is in winter 5°40 higher than north of 28°, but that in summer it is only 1°83 higher, showing that the difference between the summer and winter temperature, is less south than north of 28°. This is due to an astronomical law, which will be referred to more particularly hereafter; no reasonable objection can be urged to the temperature in any part of the state for the entire year. Meteorology may be said to be founded on the fact, that the rays of the sun constitute a force, which produces nearly all the changes which take place on the surface of the earth. The forces of the earth itself, such as gravity, chemical affinity, cohesion, electricity, or magnetism, etc. are forces of quiescence, that tend to bring matter to a state of rest at the surface of the earth, from which, it is only disturbed by the solar emanations. All elementary substances which constitute the surface of our planet, with the exception of organic matter, have long since gone into a state of permanent combination, and seems to have passed through intense heat, at some remote period of the past. "The whole earth," says Professor Henry, "is an

immense slag, analagous to that drawn from the smelting furnace, surrounded by a liquid and aerial envelope. The former in a state of ultimate chemical combination, and the active principle of the latter, oxygen, finding nothing to combine with, except what has been released from former combinations, by the action of the sun." If, therefore, the solar impulses were suspended, all motion on the surface of the earth would cease, the aerial and the ocean currents would stop, and silence and death would reign supreme. The earth in her revolutions around the sun describes not a circle, but an ellipse, in one of the foci of which, is placed the sun, so that we are nearer the sun at one part of the year, than at another. It has been mathematically shown that the earth, as a whole, receives the greatest amount of heat from the sun on the first day of January, and the least on the fourth day of July (not on our hemisphere, but on the whole earth.)

The variation of the distance of the sun from the earth, however, produces no effect on the different seasons, as many suppose, since the rapidity of motion, or the shorter duration of proximity to the sun, just compensates for the greater intensity of the sun's rays, due to the near approach. Owing to the spherical form of the earth, the sun's rays strike it obliquely at all places, except those over which the sun is vertical, and where his rays are perpendicular, and it is these vertical rays alone that produce results. The intensity of the rays will be greatest over the equatorial regions during the year as a whole, and will diminish to the poles.

The sum of all the vertical rays from the rising to the setting of the sun, on any day, will represent the whole intensity of the heat of the sun on that day, received on any parallel of latitude on the earth, and in this way may be calculated the relative amount of heat received on different latitudes at different seasons of the year; from this

estimate we shall find that the amount of heat received, during any given day of summer, from the sun, at different northern latitudes, is greater than that which falls on the equator during the same time. This is shown in a table found in L. W. Meech's paper, "on the Sun's Intensity," published in the Smithsonian contributions in 1855, which table will be found in the Appendix. On the 15th of June, the sun is more than 23° north of the equator, and, therefore, it might be readily inferred that the intensity of heat should be greater at this latitude than at the equator, but that it should continue to increase beyond this, even to the pole, as indicated by the table, may not, at first sight, seem so clear. It will, however, be understood, when it is recollected that the table indicates the amount of heat received during the whole day; and though in a more northern latitude, the obliquity of the ray is greater, and on this account the intensity should be less, yet the longer duration of the day is more than sufficient to compensate this effect, and to produce the result exhibited, an increased amount of heat. And although there is more absolute heat at Jacksonville, Florida, during the entire year, latitude 30° 20, than there is at Milwaukie, Wisconsin, latitude 43° 03, yet there is more heat received from the sun at the latter place, during the three summer months, than at the former, during that period, and Wisconsin is liable to experience a higher temperature during the summer months, than is Florida during the same time.

An analagous, but contrary result, is exhibited in regard to the cold of winter, as will be seen by the tables appended. It is on this principle that, as we come from the north towards the Equator, we find the extreme variation of the seasons becoming less and less as we advance. The curve representing the sun's intensity very nearly corresponds with that of temperature in the Equatorial regions, but it becomes more bent in comparison as we proceed north.

Upon this fact the greater equibility of the temperature of Florida is established over all places north of it, so far as astronomical influences can effect it, and not as liable to extremes of heat in summer, nor of cold in winter.

There are other causes, however, not astronomical, which materially modify temperature in all latitudes, and we must determine if any of these influences are in operation here, and if so, what effects are produced.

What becomes of the heat received on the earth from the sun's rays? Heat is indestructible, and if it continues to accumulate on the earth's surface, it will soon become so intense as to render it an unfit residence for man, animals, or plants. Although not in the order which I first intended to discuss 'this element of climate, yet the theory of radiation of heat may very properly be introduced here, in answer to the above interrogatory—what becomes of the heat?

It is a well established fact that all bodies are radiating heat, even while they are receiving it. If the amount received in a definite time, is greater than that given off, the temperature will increase. On the contrary, if the amount given off, is greater than the amount received, then the temperature will decline. The earth is constantly radiating heat into space, but only receiving it from the sun during the day. The rays of the sun are rays of high intensity, and have great penetrating power, but the rays which the earth gives off, are of low intensity, and have feeble penetrating power, unless the heat is accumulated so as to make it intense. For example, those of high intensity will pass through the glass of a window into a room, and heat up the articles in it, if they are not good conductors of heat. The articles in the room will begin also to radiate heat, but of low intensity, which cannot pass back through the window, hence the room acquires and maintains a high temperature from the accumulated heat received and not given off.

The atmosphere which envelopes the earth produces a similar result. The rays of the sun are transmitted through it to the earth, which in turn emits rays of low intensity that do not so readily penetrate and pass through this atmospheric envelope, but give rise to an accumulation of heat at the surface. The resistance to the transmission of heat of low intensity, depends upon the quantity of vapor in the atmosphere, and perhaps, also, to the density of the air itself. The radiation of the earth, therefore, differs very much on different nights and in different localities. In places where the air is very dry, the heat of the day is excessive, notwithstanding the radiation which is going on, but the nights become very cool. Gen. Emery, in his report on the Boundary survey, states that on some of the arid plains over which he passed, there was a difference of 60° between the temperature of the day and that of the night; the air was so dry here that heat of low intensity would be radiated, so that on one occasion, when the camp ground was chosen in a gorge, between two steep hills, the inter-radiation between them, prevented the usual fall of the thermometer, and it stood several degrees higher than on the plain but a few rods off. Prof. Tyndall, who belongs to a new school of philosophers, in an article on radiation, uses the following language: "The observations of meteorologist, furnish important, though, hitherto, unconscious evidence of the influence of this agent, (vapor in the air.) Whenever the air is dry, we are liable to extremes of temperature. By day, in such places, the sun's heat reaches the earth unimpeded and renders the maximum high; by night, on the other hand, the earth's heat escapes unhindered into space, and renders the minimum low, hence the difference between the maximum and minimum is greater where the air is dryest. Wherever drought reigns we have the heat of the day forcibly contrasted with the chill of the night. In the Sahara, itself, when the sun's rays

cease to impinge on the burning sands, the temperature runs rapidly down to freezing, because there is no vapor over head to check the calorific drain. And here another instance might be added to the number already known, in which nature tends, as it were, to check her own excess. By natural refrigeration, the aqueous vapor of the air is condensed to water on the surface of the earth, and as only the superficial portions radiate, the act of condensation makes water the radiating body. Now experiment proves, that to the rays emitted by water, aqueous vapor is especially opaque. Hence, the very act of condensation consequent on terrestrial cooling, becomes a safeguard to the earth, imparting to its radiation that particular character which is most liable to be prevented from escaping into space.

It might be argued, however, that inasmuch as we derive all our heat from the sun, the self same covering, which protects the earth from chill, must also shut out the rays of the sun. This is partially true, but only partially. The sun's rays are different in quality from the earth's rays, and as it does not follow that the substance which absorbs the one, must necessarily absorb the other. Through a layer of water, for example, one-tenth of an inch in thickness, the suns rays are transmitted with comparative freedom, but through a layer of half this thickness, as Meloni has proven, no single ray from the warmed earth could pass. In like manner, the sun's rays pass with comparative freedom through the aqueous vapour of the air, the absorbing power of this substance being mainly exerted upon the heat that endeavors to escape from earth. In consequence of this differential action upon solar and terrestrial heat, the mean temperature of our planet is higher than is due to its distance from the sun. A cobweb spread over a blossom is sufficient to protect it from nightly chills, and thus the aqueous vapour, attenuated as

it is in our air, checks the drain of terrestrial heat and saves the surface of our planet from the refrigeration which would assuredly accrue, were no such substance interposed between it and the voids of space."

I have dwelt longer on this particular element of climate than I would have done, had not one of the principal objections to our climate been its "*excessive humidity*," and to meet this objection I have made lengthy quotations from authorities, from which it appears that humidity in the atmosphere is essential to protect us from those extreme diurnal changes of temperature which so seriously detract from those climates where they exist, and where the diurnal changes exceed the range that I have ever recorded between the maximum and minimum of a month, when several days, or weeks, perhaps, had intervened between the extreme high and low temperature; indeed, the difference between the highest and lowest that I have recorded in thirty-six years, is not so great as is the diurnal difference in many places where a very dry atmosphere exists. I give an abstract of my own records, for the months of November, December, January, February, and March, five months, as deduced from several years' observations. The mean diurnal range for November is 13°4 for December, 13°9; for January, 14°4; for February, 14°0; for March, 14°9. These are the five months in which visitors are particularly interested, and they are also those in which the greatest diurnal variation occurs during the year.

The average number of frosts for the month of January, in Jacksonville, in twenty-seven years' record, is 5.4; for February, 3.1; for March, 1.3; for April, 0.2; and no more until October, 0.2; for November, 2.3; for December, 5.2. The first frost in the Fall has occurred in October, four times; in November, sixteen times; in December, seven times; and twice the second frost has occurred in February. There have been several years in which no frost

occurred in October; there have been years in which none have occurred in November or December. There have been years when no frosts occurred in January, none in February, still more in which March was exempt; very few frosts have occurred in April, and none after. In 1858, a frost occurred on the 28th of April, which is the latest recorded; and there have been but four Aprils in which frosts have been recorded; and there have been but four Octobers in which they have been recorded. From these statements, an idea can be formed of the average amount of freezing weather in winter. December and January are the oftenest visited with frosts, a little over five times in each month on an average.

As clearness of sky is connected with the subject of radiation, and is also an important element of climate, it will be introduced here. I have, in making up my results, of which I propose to present an abstract, counted those days clear which were marked from 0 up to 5, the latter representing the sky half covered with clouds. The month of January, from twenty-two years' observations, has had an average of 20.3 clear days; February, for twenty-five years, 19.5; March, for the same period, 20.4; April, 25, May, for twenty-six years, 22.1 clear days; June, for twenty-five years, 17.1; July, for the same period, 18.5; August, for twenty-six years, 19.1 clear days; September, for twenty-four years, 17.2; October, for twenty-five years, 19.2; November, for twenty-four years, 20.0; December, for the same period, 20 clear days. For Spring, the average is 63.7; for Summer, 55.1; for Autumn, 56.4. for Winter, 59,8; and for the year, 235 clear days out of 365, leaving 130 days in which the sky was more than half covered with clouds, and on some of which rain has fallen. In January, there has been an average of 6.6 rainy days; in February, 3.6; in March, 5.7; and in December, 5.4 rainy days, and these constitute the four months in which

visitors are especially interested. In these months we have an average of 21.3 rainy days out of 121 days.

I have not calculated the results for the other stations in the State in relation to this subject, but from a pretty careful examination of them, I judge that the results would not materially vary from what I have given from my own tables: and, on the whole, the preponderance of clear over cloudy and rainy days, speaks decidedly in favor of our climate, as being characterized by a fair amount of pleasant weather. The term relative humidity, as used in our meteorological tables, is calculated to produce on the minds of those who have not especially informed themselves of its real value, in absolute moisture, which is contained in the atmosphere, a very erroneous impression. When the temperature is 50°, the barometer 30.00, and the relative humidity marked 100, there is in one cubic foot of air only about four grains of water. If the temperature is 100°, the barometer the same as before, 30.00, and the relative humidity still recorded 100, a cubic foot of air will contain 20 grains of water. Now if the temperature is again reduced to 50°, the barometer the same, 30.00, and the relative humidity recorded still 100, the cubic foot of air will have parted with 16 grains of water, and it will be still saturated, although it contains but four grains, only one-fourth of the weight of water that it did at the temperature of 100°. Very few would appreciate this difference by looking at the record; if they have relative humidity recorded at 100, they would, without understanding it, pronounce the climate a very damp one, and this, no doubt, has led many to believe this climate to be excessively damp, as it has often been considered. Let us reverse the calculation just given; suppose instead of the temperature being 50°, it was 100°, and there was no accession of moisture, the cubic foot of air would contain four grains of water, while a cubic foot of air is capable of containing 20 grains at

that temperature, it is clear that four grains will only saturate one-fourth of it, and one-fourth of 100 would be 25; and if many should see in the column of relative humidity the record 25, they would be very well satisfied that this was a very dry climate, and yet there is no less absolute moisture in it than there was when recorded 100, and the temperature 50°.

I have been thus particular in endeavoring to place this matter in a clear light, because it has been the cause of much disparagement of our climate, from the fact that the term relative humidity has not been understood by the objectors. I have determined from my own tables the relative humidity approximately by taking the mean temperature of the month, and the average difference between the dry and wet bulb thermometers, the mean of the dry bulb being the same as the mean temperature of the month, and with these I deduce the relative humidity by the assistance of the tables provided for the purpose, and the following is the result: for the month of January, the relative humidity is 67.20; for February, 67.15; for March, 57.50; for April, 63.20; for May, 62.60; for June, 73.3; for July, 74.7; for August, 73.4; for September, 76.8; for October, 74.4; for November, 71.5; for December, 74.0; for Spring, 61.0; for Summer, 73.8; for Autumn, 74.2; for Winter, 69.4; for the year, 69.6; the annual and winter mean being nearly the same, showing a considerable amount of moisture in the atmosphere, but by no means an "excessively damp climate," for the annual mean shows that upon an average there is but (5.7) five and seven-tenths grains of water to the cubic foot of air, not deleterious to, or uncomfortable for respiration, and keep the air passages properly lubricated, but enough to prevent those great diurnal extremes of temperature so deleterious to the health and comfort of mankind. Here, as well as elsewhere, where rain falls, there must be times when the air is fully

saturated, else there could be no precipitation, and agriculture, or fruit-growing, could not be prosecuted to advantage, nor would it be a comfortable residence for man.

In its topography, Florida presents no mountains and no elevated plateaus exceeding three hundred feet above the sea, by which it is bounded on all sides, except on its northern border; but it is not, as many times represented, a low, flat, marshy country, for in many portions its surface is undulating and rolling. Its area covers 59,248 square miles of pine land, oak hammocks, flat savannas, numerous clear fresh water lakes and rivers, which add beauty to the landscape, comfort, pleasure, and subsistence to the inhabitants in their vicinity, for most of the two latter are liberally stocked with fine varieties of fish. Many of our springs, and small lakes even, are artesian, and rise from the substrata of rocks upon which the arable soil is based, and pour out copious streams of water to augment the volume of our rivers, which discharge into the sea. The probable sources of these are in the higher lands, on our northern border, and are supplied by the rainfall of neighboring States. The State is, in some portions, traversed by subterranean streams of considerable size, whose course, in many instances, is marked by the line of funnel-shaped sinks, where the sand above the rocky strata has filtered down through abrasions of the rocks, and has been carried off by the current beneath, leaving the sink, at the bottom of which water is always present, and in many of which fish are abundant. Most of these subterranean streams have their outlets in the springs above described, but some are known to discharge into the sea off the Atlantic coast of the Peninsula, and with sufficient force to displace the denser salt water, so that fresh water has often been obtained at sea, simply by drawing it up in buckets over the vessel's sides. Many of these artesian fountains are mineral; sulphur, iron, magnesia, lime, etc., being the constitu-

ents. There are but few extensive marshes in the State. At the sources of the rivers, on the summits, are often found savannas, covering many acres, but they do not, like the marshes and savannas in many other countries, consist of deep alluvial deposits, which have been brought down from higher elevations, because these are the summits themselves from which the water supply of the rivers come. This is a peculiarity in Florida, and the residents around these savannas are not specially liable to diseases of a malarial character. That large area on the lower end of the Peninsula, called the Everglades, and covered by water, is by many supposed to be marshy; but such is not the fact, for it is simply a shallow lake, elevated above the ocean some ten or more feet, surrounded by a rocky rim, with a sandy and rocky bottom, containing clear fresh water, which is discharged through fissures or apertures in the rocky rim into Key Biscayne Bay, and probably through outlets on the west side into the Gulf. At the north of the Everglades is Lake Okechobee, the largest body of fresh water in the interior of the State. It is fed by the Kissimee River, whose source is in the same savanna, or summit level which is the source of the St. John's River. Its outlet is into the Everglades. Interspersed through this savanna, and that at the head of the Oclawaha River, are numerous lakes, which, by modifying and equalizing the temperature, render the country around their borders peculiarly adapted to the culture of oranges and other tropical fruits, while at the same time the residents in general enjoy good health, both summer and winter.

There are here, as well as in every newly opened country, some localities where diseases, termed malarial, will for a time prevail, but are here of a mild form and easily managed. Having alluded in this general way to the topography of the State, we will now give an abstract of the rainfall, the materials for which consists of records from nine stations

in the peninsula, and two in West Florida. I regret that I have none from the middle district. From my own experience here, I am satisfied that to be able to determine satisfactorily the amount of rain which falls on any locality, the observations should be extended over a period of at least ten years, in order to obtain a fair mean, for I can select from my own tables one, two, and three years, and which sometimes come in succession, that are peculiarly dry years, or peculiarly wet ones, from which, if a mean was struck, it would not be a fair average. Our so-called rainy season, though sufficiently marked to warrant the designation during most years, is not always so well defined. It generally embraces a period of about sixty days and ordinarily commences about the middle of June, and terminates about the middle of August, but it oscillates from May to September. Sometimes the rainy season apparently commences, and perhaps daily showers will recur regularly for one or two weeks, or more, and then, perhaps, weeks of clear, settled weather will be interpolated, and the rainy season will come on again, and continue, so that about the usual complement of rainy days will occur. During the rainy season, the rain is by no means continuous, but comes in showers of from a half to one hour or more in continuance, and between the hours of from 1 to 4 P. M., sometimes, but not always, attended with thunder and lightning.

Before the shower, the atmosphere may be hot and sultry, but afterwards the sun shines out, the air is pure, cool, and refreshing. The showers generally come with such regularity, that they need not interrupt business, labour, or pleasure, only during their continuance, for timely preparation to avoid them can be made if desired. Sometimes they are preceded by squalls of wind, which might endanger small crafts on the river, if ordinary precaution was not taken. Occasionally a fall of hail will

result, if clouds from different directions meet, as is sometimes the case, but instances where damage has been done to vegetation have been very rare. The moisture evaporated from the Gulf is the principal source of our summer showers. In the appendix will be found the table showing the rainfall of the State. Here are eleven stations scattered over the State. You will observe that in the Peninsula the stations of Fort Myers and Fort Pierce, the former on the Carloosahatche, on the west, and the latter on Indian River, on the Atlantic, furnish the largest amount of water. These show that the water shed supplying the Everglades, and the St. John's receives the greatest rainfall. Pensacola, in the west, receives the next greatest amount, and Tampa the next. Take Tampa, Fort Myers, and Fort Pierre, we have a rainfall of sixty inches during the year, and this district is marked sixty inches on the Hyetal charts, which have been constructed to show the rainfall of the United States, and in the West there exists another such region in the eastern portion of which, Pensacola is located. This is also marked sixty inches, and are the only localities in the United States, except one other on the Pacific coast, at the mouth of the Columbia River, Oregon, that is marked as high. The rainfall of the State north of north latitude 28°, and east of Pensacola, is about 44 inches annually on the average. I have recorded an annual fall as low as thirty-five inches in Jacksonville, and as high as sixty-seven inches, hence, I conclude, that the mean given to St. Augustine, 31.80, does not represent the average rainfall of the place, and was deduced from one and a part of four years' observations. The annual rainfall of 1857, as reported by Dr. Mauran, was 40.85 inches, which is low in comparison with other stations, except Fort Mead, which is 40.22 inches. There are causes which are known, that accounts for the smaller amounts of rainfall at St. Augustine. I have often, when on the sea

islands, on the Atlantic coast, witnessed the influence which the sea breeze exerted in preventing the rain cloud approaching from the west, from reaching the coast.

I have, in the early summer, just after the rainy season had set in here, often gone to the islands, and not a drop had fallen there yet; nor on the main land which lay immediately on the coast; and I have seen the clouds approach from the west or southwest, and would be arrested over the main land one or two miles distant, and in sight, and pour down rain freely for an hour or more, but not a drop would fall on the island where I was, and this action of the sea breeze no doubt accounts for the smaller amount of rainfall at St. Augustine, situated as it is on the coast. In a short time, however, the summer rains reach the coast, because the easterly winds become less prevalent in June and July than previously. I have also noticed that the winds and rain clouds were disposed to follow the course of the river, through its different reaches, during the summer, sometimes to the advantage and sometimes to the detriment of those passing up and down in small boats. Rain, in many instances, will pour down on the river itself, while scarcely a drop will fall on the banks. I have often seen rain apparently falling on a point five miles above this city, but upon inquiry none had fallen there, or here, but there had been a smart shower on the river between the two places. I mention this fact now, as I shall use it hereafter to illustrate phenomena, which may have an important bearing upon the climate of Florida. The amount of rain measured in any one locality may not give the exact amount which has fallen on the region around in the vicinity. There are several causes which may, and often do, produce discrepancies in the results of different observers. An elevated rain gauge is not likely to measure as much as one on the surface of the earth, because when the air is saturated, a drop of rain passing through it, from

the upper to the lower gauge, will increase in bulk during its passage, hence the lower one will measure the most. In the same place, with but few rods intervening, the results given by two observers may be unlike. Showers in narrow lines often fall so that one gauge would have a sensible quantity for measurement, while over the other there was but a sprinkling of rain, and none to measure. The results given are, therefore, but an approximation to the exact truth, but taken through a long period of time the results may be considered entirely reliable if the measure has been properly placed.

In order to be able to understand many other meteorological phenomena, it will be necessary to have at least a general knowledge of the laws which govern the barometrical pressure of the atmosphere, and especially its relation to the theory of the circulation of the winds. The accumulation of the atmosphere over head causes barometric pressure, producing a rise of the column of mercury in the instrument. Now the atmosphere has the credit of extending to various altitudes from forty to even two hundred miles, but it may be put at about fifty miles as the upper surface of the atmosphere. The lower strata being the most dense and becoming less and less so as we go up. The barometer at the sea level stands at 30.00 inches, and at 3.4 miles above the sea level the barometer stands at 15.00 inches, so that one half of the atmosphere in weight is below that level, and which is much below the top of many of our mountains, and very much below the elevation to which balloons have attained. When air is heated, either by the direct influence of the sun, or by currents of higher temperature, its particles expand farther than what is due to their relief from pressure, they become lighter and ascend higher into space, and spread out and flow off laterally. Under this column the barometer will fall because of the diminished pressure. The contrary

takes place when the air is condensed by cold and when the aerial masses flow together to fill up the space left void by condensation, the weight of the column is increased and the barometer rises. A fall of the barometer, unlike that of the thermometer, indicates an increase, while its rise indicates a diminution of temperature. This is so much the case here in Florida that from the barometer alone, we obtain a close approximation to temperature, as well as atmospheric pressure. I have often amused myself in the construction of a diagram on which I have protracted the curves of the thermometer and of the barometer, making the figures of one increase from the top downwards, and the other from the bottom upwards, and the parallelism thus shown between the curves was remarkable. But this was not so at the North and in New England, and this is another fact which shows ours to be the more equable climate. At the North, and in New England, pressure and temperature are both liable to frequent fluctuations and attended with storms of greater or less severity. This equability of pressure does not exist to the same degree as here, in the islands of the gulf south of us, for there, there are often sudden and rapid fluctuations, which indicate dangerous atmospheric disturbances, which portend or accompany storms of a violent and cyclonic character, which take a spiral course, and under the influence of which we are occasionally, but very seldom, brought, at least here, on the base of the Peninsula.

This parallelism of the barometer and thermometer curves, was noticed by Prof. Russell, an eminent Scotch meteorologist, who visited this country several years ago, and lectured at the Smithsonian Institution, Washington, and he found that it existed in the States south and west of the Alleghany range. The pressure of the atmosphere varies over different degrees of latitude. At the Equator, says Reclus, the barometer stands at about 29.84 inches, but

from latitude 10 to 30, or 35 N., it increases so that it stands at or above 30.00 inches, and this after being reduced so as to obtain the pressure only. I will here remark, that we are in this latitude, under the belt of high barometer, for the mean of my own observations shows, that the barometric pressure is about 30.100 inches, one-tenth of an inch above 30 inches. The results at the Signal station here, confirm this; at New Orleans and along this line of latitude, similar results are observed, and this belt of high pressure is the dividing line between the trade wind belt of the Tropics, and the belt of westerly winds north of the trade winds. And a belt of high barometer divides the westerly wind belt from the Polar belt, to which I shall more particularly refer presently. There are other minor oscillations of the barometer which it is not necessary in this discussion to refer to, and I will now proceed to discuss one of the most important elements of climate. The atmospheric circulation or the system of winds of the Northern Hemisphere, as they affect us in these latitudes. The sun here is the great motive power which destroys the equilibrium of the atmosphere, and gives rise to all the currents which circulate over land and sea. In obedience to physical law, the repulsion of the atoms of the air are increased by being brought closer to each other by pressure, and it is also increased by the addition of heat. If water at ordinary pressure is converted into steam or vapour, a cubic inch of water is transformed into about a cubic foot of vapour, the atoms of vapour are, therefore, twelve times farther apart than when they were in a state of water. The action of heat has had the effect of putting every atom in a state of repulsion, with regard to its fellows. Every one tends to fly off from the other with as much force as if each was under the influence of a powerful spring. This intensity of the repulsion of the atoms constitutes the force

of vapour. The density of the air at the surface, and its levity in the upper atmosphere, tends to produce an equilibrium of the whole atmospheric mass, but in a most delicate kind of balance, liable to be disturbed by the slightest accession of heat in any part of the mass. Understanding this delicacy of balance, we proceed to demonstrate what effect the addition of heat has on the general circulation of the atmosphere.

The atmosphere within the tropics being heated, expands and rises upwards, the denser air on either side, north and south, press in to fill the void made by the ascending column, and a surface current would thus be established back to the pole; the heated air at the equator rises up until the levity of the air above on each side will allow the ascending column to flow off laterally north and south to the poles; and thus we have an upper current from the equator to the pole established, which unites and becomes continuous with the surface current from the pole to the equator, and would continue to pass in this current continually, all the while endeavoring to restore the lost equilibrium. But these currents cannot restore lost equilibrium, because of the constant addition of heat at the equator, and the distribution of it towards the pole, and they cannot flow along the meridians in consequence of the rotation of the earth from west to east; but those at the surface will take a westerly course, while those above will flow in an easterly direction. When the upper current has reached the 30th degree of latitude, owing to the spherical form of the earth, the meridians have so closely approached each other, that space sufficient is not allowed for the wind to flow in the same plane, and the result of this necessity is, that that part of the upper current is forced down to the earth, and returns back, mingled with the surface current, and makes the trade wind of the tropics; and another portion in its conflict with the surface current

creates a new belt of winds, which constitute the belt of westerly winds north of the trade wind belt, and a portion of the upper current still passing on until in consequence of the still diminishing space between meridians in the plane of the upper current, another descent is made to the earth, and the northern boundary of the westerly belt is there established, which is also the southern boundary of the polar belt, which extends to the pole, where the winds are southerly. (I am of course referring to the Northern Hemisphere.) This is the theory of the atmospheric circulation, described in my own language, as succinctly as possible, and now I propose to bring to bear upon this subject the result of an analysis of the observations taken at over six hundred stations on land on the Northern Hemisphere, made by Professor Coffin, in his great work on the winds of the Northern Hemisphere, and from observations innumerable, furnished by the wind and current charts of the Atlantic and Pacific ocean, collected by Prof. Maury.

Professor Coffin's work was published as contributions to science, by the Smithsonian Institution, in 1850, in which there is shown great research, and an almost infinite amount of labour, and his results are now accepted in all parts of the civilized world, as reliable authority; and after concluding his labours, he modestly asks, "Do not the results authorize us to lay down the following, as a general description of the winds of the Northern Hemisphere? 1st. That from high northern latitudes the winds proceed in a southerly direction, but veer to the west as they approach a limit, running from about latitude 56° on the western continent, to about latitude 68° on the eastern, where they become irregular and disappear. 2d. That further south, there is a belt of westerly winds, less than two thousand miles in breadth, encircling the earth; the westerly direction being clearly defined in the middle of the belt, but gradually disappearing as we approach the

limits on either side. 3d. That south of the Zone last named, the mean direction of the wind is easterly." Or in other words, he determined that in the northern belt, he found that the winds were northerly, in the middle belt westerly, and in the tropical belt easterly. There were local influences in different localities to render the winds conflicting, and it was a difficult task to reduce them all to their mean normal direction, and establish the results which conform to the theory of atmospheric circulation in most particulars. There are some localities where the local influence predominates over the general, in giving direction to wind currents, of which he became fully aware. In making his reductions, he assumes that the wind in its normal course is one hundred, and in reducing conflicting winds to the normal course, that a certain amount of their force and velocity in moving in that course has been lost by conflicting forces, and the rate of progress given, is a fraction of one hundred. If for instance, we take St. Augustine, as reduced from four years observations of the direction and force of the wind at that place, the mean direction for the month of January, was found to be N. 9° 27' E., for February, S. 78° 53' E., for March, S. 81° 52' E., for April, S. 74° 32' E., for May, S. 65° 12' E., for June, S. 85° 29' E., for July, S. 61° 5' E., for August, S. 54° 48' E., for September, N. 76° 42' E., for October, N. 57° 26' E., for November, N. 37° 58' E., for December, N. 56° 13' E., and for the year, reduced to a mean was, N. 79° 19' E., being not quite two degrees N. of East, and the rate of progress was twenty-five, only one-fourth of the rate of its normal course. I give this as an illustration of his process of reduction, from months to yearly means. I put in tabular form, several points in Florida, in order to determine the mean direction of the wind in all parts of the State, and will give the yearly means and the number of years covered by the observations; and here, as well as in

other observations, it is desirable to have an as extended a series as possible, to obtain exact results.

For St. Augustine, from four years' observation, the mean direction was, N. 79°19 E. Rate of progress, 25.

For Fort King, from three years' observations, the mean direction was, S. 4°50 W. Rate of progress, 17.

For Tampa Bay, from six years' observations, the mean direction was, S. 36°5 W. Rate of progress, 11.

For Pensacola, from seven years' observations, the mean direction was, S. 23°48 W. Rate of progress, 19.

For Cape Florida, from one year's observations, the mean direction was, S. 47°59 E. Rate of progress, 20.

For Carreysford Reef, from one year's observations, the mean direction was, N. 82°25 E. Rate of progress, 32.

For Indian Key, from one year's observations, the mean direction was, S. 89°44 E. Rate of progress, 47.

For Tortugas Island, from one year's observations, the mean direction was, N. 65°29 E. Rate of progress, 48.

For Key West, from four years' observations, the mean direction was, N. 78°6 E. Rate of progress, 38.

The mean direction of the winds at Pensacola, are up the valley of the Mississippi, and those next prevalent are down and towards the Gulf of Mexico.

Those south of the 28th degree of latitude, when reduced to a mean direction would be a little north of east or N. 80°8 E., with a rate of progress of 35, would blow across the Gulf towards Mexico, and be deflected upwards, and would enter the valley as a southerly wind, while those north of 28th degree would be S. 38°4 E., would blow up the Atlantic coast towards the Alleghany range, and as their rate of progress would be but 10 they would not surmount the range, and would follow the coast to the east of the range. These results show that our winds partake of the monsoon characteristics, and in summer blow towards the land when it is heated. But the direc-

tion of those above the 28th degree of latitude on the Peninsula blow up the Atlantic coast, but the rest are carried up the valley of the Mississippi, and this valley is one of those extended plateaus, which, when heated by the sun in summer, would draw the winds from the adjoining seas, to supply the void made by the rarification and ascension of heated air over its extended area. The influence of the valley of the Mississippi, upon the weather of the United States is much greater in my opinion than has been heretofore accredited to it. The valley is open on the south to the Gulf of Mexico, and is bounded on the west by the Rocky mountain range, which has a direction from south-east in the lower end of the valley to north-west, and extends to the polar basin in the north. At the lower and southern portion it has the Alleghany range for a boundary on the east, which has a direction from south-west to north-east, and its southern termination is as far west as the 89th degree of longitude, and west of any meridian that passes over Florida.

This valley, however, does not terminate at the sources of the Mississippi River, but extends still northward until it reaches the polar basin; no ridge of mountains cross the valley to separate the lower part from the polar basin, or prevent the winds of the polar regions from traversing its entire length; nor those from the Gulf of Mexico, which alternately move up and down this valley—the one cold and dry, and the other hot and loaded with moisture from the Gulf, the Caribbean Sea, and from the Equatorial regions of the Atlantic farther south. In this valley are exhibited some of the most interesting and remarkable meteorological phenomena that arise on the face of the globe, and which give character to the climate of the Northern, Middle, and New England States. In the summer, this extended plateau is heated by the rays of the sun, the atmosphere being rarified and ascends, the rain,

bearing winds from the Gulf and below, rush up the valley, distributing their rains which give it its wonderful fertility; which winds are, however, replaced, or alternated by those cold, disagreeable winds, termed the northers, which visit Texas, Mexico, and, in a modified form, Cuba and the other West India Islands, and perhaps the lower point of our Peninsula. These northers have heretofore been considered deflected trade winds. But I am disposed to differ with those who have entertained this opinion—first, because most, if not all, of this valley is not in the trade wind belt, but north of it, and in the belt of westerly winds, which has been shown by Professor Coffin to encircle the earth. I object, in the second place, to this view, because there is a more natural and simpler mode of explanation of the phenomena. I have observed, and so have many others, who have had their attention drawn to the matter, that winds are disposed to follow water courses, in well defined valleys, in preference to blowing across them. I have remarked previously that such was the case in the valley of the St. John's, which is by no means as well defined a valley as many others.

But Professor Coffin, in his efforts to reduce conflicting winds to their normal direction, found it very difficult, to do so, when well defined valleys existed, and this is the conclusion to which he arrived, after giving the subject more study than has been given to it probably, by any other man. Says he: "In any well defined valleys of considerable extent, it is a well known fact, that the winds are influenced to take the direction of the valley. An example is given of the Hudson River Valley, where half of the winds or more follow the river up and down; and yet, (says he) the mean direction of the winds of the whole is nearly at right angle to it." Now if we make application of this well established principle to the Mississippi Valley, which certainly is a well defined one, what is the result? As the

winds of the polar belt have been shown to have a southerly direction by Prof. Coffin, there is nothing to prevent their free entrance into that broad northern mouth of this valley, and the high wall of the Rocky Mountains on the western boundary of the valley for its entire length would tend to continue this direction to the Gulf of Mexico, and even beyond, for the mountains of Mexico, the Sierra Madre, are but the continuation of the Rocky Mountain range, extending to Central, and even South America, curving to the eastward, so as to embrace the Caribbean Sea, and then taking a southern direction, and joining the Andes. This is the course taken by the polar winds, and they constitute the northers, which are cold and disagreeable, and these polar winds also are probably the main cause of those sudden atmospheric disturbances which are generated so frequently in the sea of the Antilles, those terribly destructive hurricanes, and cyclones. The direction of the Mississippi valley is at right angles with the westerly belt of winds as defined by Coffin, but the winds of this belt in their course from the Pacific have to surmount the Rocky Mountains, and necessarily pass high over the valley, especially if it is already occupied by the surface currents either from the north or south. The winds from the polar basin would move close to the surface in consequence of their greater density, due to dryness and cold. If the rain-bearing winds from the south should meet those from the north with anything like equal force, there would necessarily be a conflict in opposing directions, and a mingling of the winds from opposite directions, and some new direction would be given to the opposing currents. They could not return back upon themselves; they could not go far west, on account of the barrier opposed by the Rocky Mountain wall, and they could not be deflected readily to the southeast, because they would be met in that direction by the Alle-

ghany range? Now what way or direction is open to them? They can go to the east or northeast. And in this conflict of winds from north and south, the mass might, and probably would be elevated and carried up the eastern slope of the Rocky Mountains, until brought into the influence of the high westerly belt of winds, and then would be swept across the States north of the Alleghanies, as storm winds which would pass off the coast of New England, and follow the Gulf Stream, which is a river in the ocean, or turn further north, and pass down the St. Lawrence, another well defined river valley through which winds are disposed to blow.

The winds which come over the Rocky Mountains have hitherto been considered the great weather breeders of the Mississippi Valley, and of the Northern States. If you examine the weather charts which accompany the monthly reviews issued by the Bureau of the Signal Service of the United States, at Washington, you will observe the track of storms there laid down, marked by a continuous black line; so far as the track has been defined from actual observations, this line commences in the Valley of the Mississippi generally, and extends eastward, but not unfrequently you will find a dotted line from over the top of the Rocky Mountains, which is made to connect with black lines representing the observed storm track; this dotted line represents the supposed course and source of the storm from the Pacific Ocean over the Rocky Mountains. The majority of the storm tracks commence in the valley, and take the directions indicated, but some come from low down the valley, and pass up in a direction from S. W. to N. E., along the western base of the Alleghanies, and some few commence in the Gulf, pass diagonally across the Peninsula of Florida, and up the Atlantic coast east of the Alleghany range. That the cold storms which traverse the plateau north of the Alleghanies come from the

Pacific over the Rocky Mountains, is, I think, a mistaken supposition, for the temperature of the Pacific side of our Continent is much higher than on the Atlantic side in the same latitude, as is shown by the isothermal lines on all our weather charts. A cubic foot of the atmosphere from the Pacific side might be carried over the Rocky Mountains, and when on the summit it would be cold, because its bulk would have expanded to that of several cubic feet, and its heat being diffused through an increased bulk, it would be comparatively cold; but after it had come over, and again been subjected to pressure in the valley, it would have lost little or none of its specific heat in its passage over, and cannot account for the cold experienced in these storms, nor for the amount of vapour condensed to produce the rain which accompanies them. And if it is admitted that the rain bearing winds from below bring the vapour up from the Gulf, why not admit that the cold dry winds from the northern end of the valley, is the source of the cold winds which does produce the condensation, and cold, also, which is experienced all over the plateau where the great lakes are situated, and over New England? The explanation here advanced, as to the influence of the winds of this great valley in producing the northers which visit Texas, Mexico, and the Islands of the Antilles, and as the breeder of the storms in the Northern and Middle States, is, in my opinion, the true one in the main; there may be, and no doubt there are, many minor influences which I have not enumerated, which enter into and modify the phenomena witnessed in these storms.

Prof. Espy used to consider the winds of the Pacific, coming over the Rocky Mountains, as the cause of the storms which swept across that northern plateau in which the upper lakes are situated; but there was a peculiarity in his weather charts, and this was a line extending north and south, of considerable length, representing the storm trav-

elling broadside eastward, moving majestically and slowly along ; but, had it come over the Rocky Mountains, would it have presented that kind of front ? The elevation of the Rocky Mountains are unequal ; there are high peaks and comparatively low walls and gorges between them. Now if the winds were pressing with great force, they would rush through the gorges between the various peaks, not in those broad masses, but in narrower streaks, which would not present the broad front which he describes. But if the storms were produced by the winds of the valley meeting from the north and south, and were elevated until they were brought into the influence of the westerly belt of winds, the storm would then present the peculiar front elongated from north to south, which he has so correctly described.

Now, in this connection, I will refer more particularly to the phenomena to which I have above merely alluded, as connected with the currents passing up and down the Mississippi Valley. I mean the violent character of the circular or spiral storms in the Gulf and Caribbean Sea, called cyclones. The spiral movement of the wind in cyclones, in the Northern Hemisphere, is from the west to east, by south, and from east to west, by north. The cyclones in the Southern Hemisphere are in the opposite direction, that is, the spiral movement of the wind is effected from west to east, by north, and from east to west, by south, and it has been explained as being the result of the meeting of the conflicting currents of the air, throwing them into spirals ; and by some, that there is some cause in operation, peculiar to each hemisphere, which causes them to revolve in opposite directions in the respective hemispheres. Without attempting to go into a solution of the difficulties which attend the theories advanced, I only wish now to simply direct your attention to the conformation of the mountainous border of the Valley of the Mississippi,

and of the Gulf of Mexico, and of the Caribbean Sea. In latitude 30°, where the 108° of longitude crosses it, to below latitude 10° N., where the 75th parallel of longitude crosses that, there is a regular curve in the mountain range turning eastward, as you go south, (and in this curve lies the Gulf of Mexico and the Caribbean Sea,) so as to give a spiral direction to the winds that are forced down the Valley of the Mississippi, and over these partially inclosed basins of water. Without insisting that these winds are the cause of the cyclones which are first formed over these bodies of water, the direction given to the winds, which are deflected from their northerly course by the curve of these mountains, would be a spiral corresponding with those which the cyclones of the Northern Hemisphere take, and if these winds do not create them, they are calculated to give force and intensity to those already formed. The diameter of these circular storms are at first comparatively small, but violent in force. After leaving the tropics, they are relieved from the lateral pressure of the N. E. trade winds, and have a free path before them, and soon come into the influence of the belt of westerly winds, bending in a graceful curve to the north and northeast, enlarging the diameter of the spirals, and consequently lose their violence as they advance, and usually following the course of the Gulf Stream. Meteors of lesser magnitude than the cyclone are often formed by the meeting of conflicting winds, and form whirlwinds on land, and waterspouts at sea. Some of these are destructive in their effects, and sometimes enlarge into local cyclones, but these, we are not called upon to discuss in this connection. From what has been shown, it follows as a legitimate result of the operation of natural influences around us, that our position is a favorable one, and is out of the track of the storms which so frequently visit our neighbors of the North; and that we are also out of the track, and protected from, these ter-

restrial influences which so violently disturb the equilibrium of the atmosphere south of us, nearer the tropics. The conflicting winds which are warring in the Valley of the Mississippi for the mastery, do not often overleap the summits of the Alleghanies to give us a taste of the quality of the storms which are carried eastward over the Northern plateau; nor do those which, in the form of northers, visiting Texas, etc., reach us, but pass us by on the west, and expend their force upon the coasts and islands of the Gulf and Caribbean Sea, and those cyclones which are born in the sea of the Antilles, pass around us, seldom making us a visit, that is, to our disadvantage, but have a tendency to remove all noxious admixture in our atmosphere, if any such exist, and substituting an atmosphere that has been purified by the tempest, which has raged to the south and east of us, the direction from which our principal winds come, and towards which they blow, while these kind of storms pass on our borders.

When treating of temperature, I neglected to notice a statement that I have seen in print relative to the extremes of temperature which had occurred in Florida. It has been stated that the thermometer here had been — 8°, or eight degrees below zero. Nothing of the kind, I will venture to say, has ever been recorded, nor has any tradition ever handed down any such event. In the month of February, 1835, occurred, probably, the coldest weather which Florida has ever experienced since it has been known, by a white man at least; at the time alluded to, the thermometer was down to 8° above zero, and great damage was done to the orange and other trees at that time, and there were standing trees on the St. John's River, and also, I think, at St. Augustine, which were a hundred years old at least, and they were killed with the rest, and this is an evidence that for a hundred years at least, such a frost had not occurred. I have once recorded the

thermometer 16° above zero, and have three times recorded it as low as 20° above zero in the last thirty-six years. It is not claimed for Florida that she is entirely exempt from all those influences which produce extremes of temperature north of us, but their effect upon Florida, in comparison with other places north and west of us, is greatly modified here, so that we can claim to have a very equable climate in comparison.

And, now gentlemen, having occupied so much of your time, and having, I believe, discussed the various topics which constitute the factors of the climate, I am admonished of the propriety of bringing this address to a close, and will do so by giving a succinct summary of what we have found to be the results of the analyses of the material which has been above elaborated. In regard to *Temperature*, that has been found excessive in neither extreme throughout the entire year, but quite equable. Atmospheric disturbances of a serious character are not as frequent here as either north or south of us, for our equable temperature has been shown to have an astronomical cause, which gives us less heat in summer, and less cold in winter than in northern latitudes. And the regularity of barometrical pressure in its relation to temperature, shows that there is a remarkable and equable relation existing between the two. The humidity of the atmosphere has been shown to exist to such an extent as to prevent those extreme diurnal variations of temperature which are inimical to both comfort and health, and on the other hand, the absolute amount of water in the atmosphere is too small to render it objectionable to even delicate lungs. The fall of rain occurs principally in showers during the summer and autumn, when the agricultural interests most require it. The winter is the dryest season and the spring next, in the latter part of which it is sometimes quite dry.

The showers which occur in summer are of short dura-

tion, and come on with considerable regularity, making the summer more pleasant and the air pure and cool. The atmosphere, as has been before remarked, is comparatively calm, and what winds we do have are seldom of a violent or destructive character.

We have on an average about twenty clear days in the month, or about two hundred and forty in the year. The excessively cloudy weather which has characterized the January of this year, 1875, is a marked exception to all former years since my residence in Florida, and has most probably resulted from some general disturbance of the atmosphere, which has at the North produced such intense cold as will probably be remembered hereafter as one of those cold winters which, at long intervals, will visit a country, but we should after all consider this character of weather as a blessing in disguise, as not the tenderest vegetable which has been exposed to all weathers has been injured by frost this winter. The electric tension of the atmosphere has been considered one of the elements of climate, but into this subject I have made no investigation, nor am I aware that any special attention has been paid to it. I will not, therefore, make any pretence of showing what, if any, influence it may have on our climate. This is one of those quiescent forces of the earth which are roused into activity by the action of the sun's rays. I have not deemed its influence sufficiently important to make it the subject of special study in connection with meteorology. I have kept a record of thunder showers, and from that I find that most of them have occurred in the spring, summer and autumnal months, and very few in the winter. Sometimes we have cloud lightning without audible thunder, on the horizon, in the evening. We have occasionally had some beautiful exhibitions of the Aurora Borealis, some of which might be termed gorgeous. Meteors and shooting stars are not unfrequently observed, and some other meteoric phe-

nomena have been observed, which it is unnecessary to allude to here. As the admixture of foreign substances in the atmosphere is referred to in Humbolt's definition of climate, I would remark that probably there may be some admixture of saline matter near the sea shore, as some vegetables will not grow there, which do in the interior. Carbonic acid gas probably exists in a moderate amount.

As the generation of ozone is accomplished in the laboratory by the transmission of electricity through oxygen, its formation is probably effected to a greater or less extent during our summer thunder showers; but I have no facts to demonstrate its existence, or its effect upon health. The subject of miasmata I have spoken of already, and we have nothing in Florida to render it the cause of disease more than in any country north of us, where new soil is turned up to the air and sun. The heat which we have, does not seem to generate any thing of the kind here, more than elsewhere. Florida is, happily, free from many of the diseases which are prevalent elsewhere. The only records to which we have hitherto had access, are those of the army, when troops have been stationed in different portions of the State, some of which might be suspected of being sickly; but these present the gratifying result that Florida is one of the healthiest States in the Union. I trust that under the auspices of this association, a systematic effort will be made to secure reliable information as to the vital statistics of the State, and the character of the hygienic condition of the residents generally and locally.

I have now performed the duty assigned me. I have analyzed the materials which I had collected, and which I believe on the whole to be sufficiently reliable from which to derive a fair result, and if the results of their analysis shall have the effect of imparting a more correct knowledge of the climate of Florida, as it really exists, the labour, which has been required to arrive at these results, will be amply repaid.

S. W. Meech's Table, Showing the Sun's Diurnal Intensity at every 10 Degrees of Latitude in the Northern Hemisphere.

		LAT. 0	LAT. 10°	LAT. 20°	LAT. 30°	LAT. 40°	LAT. 50°	LAT. 60°	LAT. 70°	LAT. 80°	LAT. 90°
January	1	77.1	67.2	55.8	42.8	30.1	16.5	5.1			
"	16	78.1	68.9	58.2	45.8	32.7	19.3	7.2			
"	31	79.6	71.7	61.9	49.7	38.6	25.0	11.9	1.4		
February	15	81.0	74.7	66.6	55.6	45.1	31.9	19.0	6.4		
March	2	81.6	78.0	71.3	62.9	52.7	41.1	27.9	14.5	2.1	
"	17	82.0	80.2	76.0	69.6	61.1	50.2	37.1	25.5	11.6	
April	1	80.8	81.4	79.5	75.6	68.9	60.2	49.9	38.0	25.6	20.5
"	16	79.0	81.7	82.0	79.5	75.1	68.6	61.1	51.4	44.0	44.6
May	1	76.9	81.5	83.7	83.6	80.8	77.1	70.9	64.6	64.3	65.3
"	16	74.7	80.8	84.7	86.7	85.7	83.3	79.7	76.8	80.3	81.5
"	31	73.0	80.1	85.1	87.8	88.9	87.8	85.7	86.8	91.0	92.4
June	15	72.0	79.6	85.2	88.4	90.1	89.9	88.8	91.7	96.1	97.6
July	1	72.0	79.5	85.0	88.5	90.4	89.5	88.4	90.8	95.1	96.6
"	16	73.0	79.8	84.7	87.5	87.6	86.5	84.1	84.3	88.3	89.7
"	31	74.7	80.4	83.9	85.1	84.5	81.6	77.3	73.4	76.2	77.4
August	15	76.7	80.8	82.7	82.4	79.8	74.7	68.2	60.9	59.2	60.1
"	30	78.5	80.7	80.6	77.7	72.1	65.5	57.3	47.7	38.8	38.9
Sept'ber	14	79.8	79.8	77.5	72.8	65.9	58.8	46.9	34.5	21.9	14.7
"	29	80.5	78.4	73.8	67.0	57.8	47.0	36.2	22.5	9.0	
October	14	80.7	76.4	69.7	61.0	50.2	38.2	25.7	12.6	1.0	
"	29	79.9	73.5	65.0	54.6	42.5	30.1	17.5	5.2		
Nov'ber	13	78.8	70.7	60.8	49.8	37.1	23.8	11.0	0.9		
"	28	77.5	68.3	57.3	45.3	31.8	18.9	6.8			
Dec'ber	13	76.9	66.9	55.4	43.0	30.3	16.3	4.9			

By the above table, the amount of sun's rays which fall on the day given, is shown on the different degrees of Latitude. The table has been computed for intervals of fifteen days, and expresses the results in *units of intensity*. The choice of a *unit* being entirely arbitrary; the intensity of a day on the Equator, at the time of the vernal Equinox, is here assumed to be 81.5, and other values are expressed in that proportion. In the last three columns for the frigid zone, the braces include values for the days, when the sun shines through the whole twenty-four hours; the blank spaces indicate periods of constant polar night.

	MEAN TEMPERATURE OF FLORIDA.							RAIN-FALL IN FLORIDA					Observation of Therm'r.		Observation of Rain-fall.	
	Latitude.	Longitude.	Spring.	Summer.	Autumn.	Winter.	Year.	Spring—inches.	Summer—inches.	Autumn—inches.	Winter—inches.	Year—inches.	No. of Year Observed.	Parts of Yr. Observed.	No. of Year Observed.	Parts of Yr. Observed.
1. Key West	24.82	81.48	75.79	82.51	78.23	69.58	76.51	8.34	16.51	15.35	7.37	47.65	14	& part of 2 years.	5	& part of 5
2. Key Biscayne	25.55	80.20	74.66	81.50	76.27	66.58	74.75	(13 26	18.89	17.11	9.78	59.04) (*)	1	& part of 9 years.	3	5 months
3. Fort Myers	26.38	82.00	75.89	82.41	77.00	68.36	75 04	11.07	30.91	11.96	8.33	62.26	4	…………	4	& part of 2
4. Fort Pierce	27.30	80.20	73.44	81.31	74.80	63.27	73.20	11.13	26.25	16.84	8.76	62.98	4	…………	2	& part of 3
5. Tampa Bay	28.00	82.28	72.06	80.20	73.08	62.85	71.9	8.57	28.24	10.63	8.04	55.41	25	…………	11	& part of 5
6. Fort Mead	28.01	82.00	71.87	79.34	73.82	60.90	71.48	8.76	20.68	69.5	3.87	40.22	2	…………	2	& part of 2
7. New Smyrna	28.54	81.02	71.80	79.14	62.43	63.22	69.17	(3.50	14.45) (*)	…………	………	…………	1	& part of 3 years.		9 months
								(5.83	19.84	11.73	7.53	44.93) (*)	……	…………	7.10	& part of
8. Cedar Keys	29.07	83.03	70.02	79.07	71.04	58.22	69.60	4.10	22.35	11.94	10.11	48.50	2	7 months	2	1
9. Fort King	29.10	82.10	70.22	80.22	70.69	58.41	70.04	…………	…………	…………	………	…………	6	…………	……	…………
10. Waucasassa	30 miles Cedar	N. E. of Keys.	70.28	78.87	69.29	57 45	68.97	…………	…………	…………	………	…………	2	3 months	……	…………
11. Palatka	29.34	81.48	70.62	83.57	70.20	57.18	69.64	12.49	21.49	9.71	4.99	48.68	6	…………	3	…………
12. Micanopy	29.30	82.28	72.02	79.55	69.80	59.98	70.09	(9.29	24.48	12.47	7.17	54 36) (*)	4	3 months	1	7 months
13. Fort Fanning	29.35	83.00	71.11	80.96	71.07	57.66	70.20	…………	…………	…………	………	…………	2	3 months	……	…………
	…………	…………	…………	…………	…………	…………	…………	(10.53	17.38	9.09	6.16	43.16) (*)	……	…………	8	& part of
14. St. Augustine	29.48	81.30	68.54	80.27	71.73	58.08	69.61	5.90	10.54	9.46	5.80	31.80	20	…………	1	4
15. Picolata	29.48	81.45	70.08	80.61	72.23	54.90	69.46	…………	…………	…………	………	…………	1	…………	……	…………
16. Pensacola	30.18	87.27	68.59	81.57	69.86	54.92	68.74	12.86	18.69	13.71	11.72	56.98	17	…………	3	& part of 8
17. Jacksonville	30 20	81.25	70.06	81.82	70.35	56.33	69.38	9.19	20.50	12.98	7.60	50.29	27	…………	16	& part of 3 years.
18. Waukeena	30.26	84.00	71.52	79.39	68.36	56.91	69.04	…………	…………	…………	………	…………	1	& part of 2 years.	……	…………
19. Knox Hill	30.30	85.30	…………	…………	…………	…………	…………	7.62	16.64	9.45	10.36	44.07	……	…………	1	7 months
Lake City	30.12	82.37	(69.0	81.3	71.6	58.3	70.0) (*)	(16.34	26.15	20.88	15.04	78 38) (*)	1	1858	2	8 months
Gainsville	(29.35	82.26	(67.32	78.42	71.12	59.59	69.11) (*)	(8.33	20.18	7.94	8.46	44.91) (*)	1	1858	4	7 months
Fort Deynard	26.30	81.30	…………	…………	…………	…………	…………	(9 34	28.06	6.99	10.71	55.30) (*)	……	…………	2	5 months
Barrancas Barracks	30.20	87.18	…………	…………	…………	…………	…………	(14.84	20.70	14.61	13.69	63.78) (*)	……	…………	3	8 months
Manatee	27.27	82.10	(72.6	83.8	76.7	65.3	74.6)	(12.90	23.10	5.60	9.08	50.68) (*)	……	…………	1	1869
SUMS			1,289.13	1,449.25	1,290.00	1,080.81		10.02	232.81	1,129.04	86 95					
MEANS			71.62	80.51	71.66	60.04	70.95	9.09	21.16	12.64	7.90	50.97				

(*) Those in brackets do not enter into the Sums or Means, as the returns are not reliable, and missing months were interpolated, and these interpolations have, at some of the stations, been so far from the actual measurement, as to materially change the result of the year, and those have been added since the tables were first constructed, and for fuller information. The annual Rain-fall of Florida, as given by the Smithsonian Tables and Results, is 49.49 inches.